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China Report

SCIENCE AND TECHNOLOGY

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CHINA REPORT

SCIENCE AND TECHNOLOGY

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PEOPLE'S REPUBLIC OF CHINA

ABSTRACTS

NATIONAL DEVELOPMENTS

LIU ZHENG ON IMPORTANCE OF SCIENCE, TECHNOLOGY

HK050713 Changsha Hunan Provincial Service in Mandarin 2310 GMT 4 Jan 84

[Text] At the provincial conference on exchanging experience in science and technical association work which started yesterday, Liu Zheng, secretary of the provincial CPC committee and governor, said: If we do not attach great importance to scientific and technical progress, the goal of invigorating Hunan's economy will become hopeless. He said: We must have a feeling of urgency regarding this issue. Comrade Liu Zheng said: The achievements in industrial and agricultural production made by the province in the 30-odd years since liberation, particularly since the 3d Plenary Session of the 11th CPC Central Committee, should be fully affirmed. However, we should realize sober-mindedly that economic development is extremely rapid at home and abroad, and that we are facing the challenge of a world industrial revolution. We should frankly admit that our province's economy is still rather backward. In order to put an end to this situation, we must rely on scientific and technical progress.

Comrade Liu Zheng stressed: Science and technology must be geared to the needs of economic construction, and must serve the invigoration of the economy. They must be geared first to the needs of Hunan's economic construction, and we must make the most of the power of science and technology in invigorating Hunan's economy. We must by no means seek things far and wide while neglecting what lies close at hand, or seek illusion while neglecting reality.

Comrade Liu Zheng said: We must spend much effort in reforming scientific and technical work. We have to reform the scientific research system and change the style of thinking in accordance with the actual conditions in Hunan, so as to open up new vistas through the practice of reform.

In his speech, Comrade Liu Zheng urged that the scientific and technical association be truly run as a home of scientific and technical workers, and that all scientific and technical workers throughout the province be mobilized and organized better to serve the invigoration of the economy.

All societies, associations, and research institutes directly under the provincial authorities, as well as responsible persons of all prefectural,

city, autonomous prefectural, and county scientific associations; and representatives of the advanced collectives and advanced individuals which are directly under them, totaling more than 300 people, attended this conference.

Yin Changmin, Standing Committee member of the provincial CPC committee, and Yang Difu, vice chairman of the provincial CPPCC committee, were present at yesterday's conference.

The Chinese Scientific and Technical Association, as well as provincial and regional scientific and technical associations, such as Hubei, Guangxi, and Sichuan, have sent congratulatory telegrams. Representatives of the Guangdong Scientific and Technical Association joined in the conference by invitation, and delivered a speech of congratulation at the conference yesterday.

CSO: 4008/105

NATIONAL DEVELOPMENTS

PROVINCIAL SCIENCE, TECHNOLOGY GROUP ESTABLISHED

HK201431 Changsha Hunan Provincial Service in Mandarin 2310 GMT 19 Dec 83

[Text] According to HUNAN RIBAO, the science and technology leading group of the provincial people's government was recently set up. Liu Zheng, provincial CPC committee secretary and governor, was appointed the head of the group and (Yin Changming), (Shi Jie), (Chi Yungui), (He Xiangchu), (Huang Peiyun), and other comrades were appointed deputy heads of the group. The responsible comrades of the provincial Planning Commission, Economic Commission, National Defense Science and Industry Office, Urban and Rural Construction and Environmental Protection Department, Labor and Personnel Department, Education Department, Financial Department, Science and Technology Commission, and Association for Science and Technology are all members of the group.

The science and technology leading group is responsible for implementing the party and state's principles and policies on the development of science and technology, exercising unified command over and coordinating the scientific and technological work throughout the province, examining and approving the province's plans for scientific and technological research and for the application and popularization of science and technology, including the plans for technical transformation in all the trades and key enterprises in the province, examining and approving the schemes for tackling and thoroughly resolving major scientific and technological hurdles, studying the decision concerning major policies related to technology, and examining and deciding matters related to major projects for introducing and assimulating foreign technology.

CSO: 4008/105

MAGNETOHYDRODYNAMIC FLOW OF TWO-COMPONENT GAS ANALYZED

Beijing LIXUE XUEBAO [ACTA MECHANICA SINICA] in Chinese No 3, 1983 pp 293-297

[Article by Rong Sheng [2837 7105], Institute of Mechanics, CAS: "Magneto-hydrodynamic Flow of a Two-Component Gas and Its Applications"]

[Text] Because of the steadily increasing need for isotope separation, increasing the homopolar separation coefficient and yield has become an extremely important problem. Mechanical centrifuges achieve separation by high-speed rotation of two different gases or liquids. But because of structural strength limitations and equipment vibration it is difficult to continue increasing their separation effectiveness. Is it possible to use electromagnetic fields to bring two gaseous isotopes to higher rotary speeds so as to achieve separation? The feasibility of this approach was first investigated in the 1960's. Gross et al. used an electromagnetic force to accelerate an ionized gas, achieving rotary speeds of 10^8 cm/sec in the laboratory. The technical difficulty in electromagnetic centrifuge separation of isotopes involves the gas ionization are relatively promising methods. The present paper gives a theoretical analysis of the flow of a two-component gas under the influence of radial and magnetic fields, derives the rotation speed, temperature and density ratio distribution, shows theoretically that the use of electromagnetic centrifugation for isotope separation can achieve relatively high rotary speeds and rather large separation characteristics and yields, and indicates the limitations on rotary speed.

Fig. 1 is a diagram of the flow of a two-component gas. The inner and outer electrodes consist of coaxial cylindrical surfaces in which there are many small holes; the gas is injected tangentially through the outer electrode and flows out through the electrodes after acceleration by the electromagnetic field.

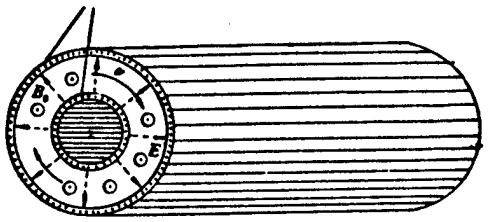

Figure 1. Flow Diagram

1. Basic Assumptions

A. The flow is constant and axially symmetrical, and the physical characteristics of the flow field are functions only of the radial coordinate r^*.

B. For a small magnetic Reynolds number, the electric and magnetic field intensities are $\bar{E} = (E_0 r^*/r_0^*, 0, 0)$, $\bar{B} = (0, 0, B_0)$, in cylindrical coordinates r^*, θ^* and z^*. E_0 and B_0 are constants, and r_1^* and r_0^* are the radii of the inner and outer electrodes respectively.

C. We neglect the viscosity of the gas, heat conduction effects, and chemical reactions.

D. The constant-volume and constant-pressure specific heats of the gases are constant.

E. The gas consists of two components of different atomic weights.

The equations defining the density, concentration, pressure, velocity vector, enthalpy, specific heat at constant pressure, specific heat at constant volume, radial flow rate and temperature of the gas are:

$$\rho^* = \rho_1^* + \rho_2^*, \quad n = n_1 + n_2, \quad p^* = p_1^* + p_2^*$$

$$\bar{v}^* = \frac{\rho_1^* \bar{v}_1^* + \rho_2^* \bar{v}_2^*}{\rho^*}, \quad h^* = \frac{h_1^* \rho_1^* + h_2^* \rho_2}{\rho^*},$$

$$c_p = \frac{c_{p_1} G_1 + c_{p_2} G_2}{G}, \quad c_v = \frac{c_{v_1} G_1 + c_{v_2} G_2}{G},$$

$$G = \rho^* u^* r^*, \qquad T^* = \frac{h^*}{c_p}$$

Subscripts 1 and 2 indicate the light and heavy components respectively. The diffusion speeds of the components are $\bar{w}^* = \bar{v}_i^* - \bar{v}$ $(i = 1, 2)$, and their radial components are u_i^*. The density ratio of the heavy component to the light component is $y = n_1/n_2$. Considering the two-dimensional case, $\bar{v}^* = (u^*, v^*, \theta)$.

2. Basic Equations, Solution Conditions and Solution

We introduce the following dimensionless variables and coefficients:

$$\rho = \rho^*/\rho_0^*, \quad p = p^*/\rho_0^* v_0^{*2} \quad v = v^*/v_0^*, \quad u = u^*/u_0^*$$

$$T = T^*/T_0^*, \quad r = r^*/r_0^*, \quad \varepsilon = u_0^*/v_0^*, \quad v_e = E_0/B_0 v_0^*$$

$$\delta = \frac{\sigma r_0^{*2} B_0^2}{\rho_0^* u_0^*}, \quad M_0^2 = \frac{v_0^{*2}}{\Gamma p_0^*/\rho_0^*}, \quad D = \frac{3m_1}{8\sigma_{12}^2 G_2} \sqrt{\frac{KT_0^*(m_1 + m_2)}{2\pi m_1 m_2}}$$

where the quantities with the subscript 0 are the values outside $r = r_0^*$ (outer wall); $\Gamma = c_p/c_v$ is the specific heat ratio of the gas; δ, Mo and D are the magnetic effect coefficient, the Mach number and the dimensionless diffusion coefficient. We use the following dimensionless equations:

continuity equations

$$\rho u r = 1 \tag{2.1}$$

$$\rho_2(u + u_2) = G_2/G = \text{const} \tag{2.2}$$

$$\rho_1 u_1 + \rho_2 u_2 = 0 \tag{2.3}$$

momentum equations

$$\varepsilon^2 \rho u \frac{du}{dr} + \frac{dp}{dr} = \frac{\rho v^2}{r} - \varepsilon^2 u \delta \tag{2.4}$$

$$\frac{1}{r}\left(\frac{dv}{dr} + \frac{v}{r}\right) = -\delta\left[\frac{v_e}{r} + v\right] \tag{2.5}$$

energy equations

$$\frac{\rho u}{(\Gamma - 1)M_0^2}\frac{dT}{dr} = u\frac{dp}{dr} + \delta\left[\left(\frac{v_e}{r} + v\right)^2 + \varepsilon^2 u^2\right] \tag{2.6}$$

state equation

$$p = \frac{\rho T\left(1 - \frac{m_2 - m_1}{m_2}\frac{\rho_2}{\rho}\right)}{\Gamma M_0^2\left(1 - \frac{m_2 - m_1}{m_2}\rho_{20}\right)} \tag{2.7}$$

diffusion equation

$$\frac{d\ln y}{dr} = \frac{-\frac{m_2}{m_1}(1 + y)(1/y - 1/y_0)}{Dr\sqrt{T}} + \frac{\left(\frac{m_2}{m_1} - 1\right)(1 + y)}{1 + \frac{m_2}{m_1}y}\frac{d\ln p}{dr} \tag{2.8}$$

The derivation of equation (2.6) uses Ohm's law $\bar{j} = \sigma(\bar{E} + \bar{v}^* x \bar{B})$. Equation (2.8) is derived from the diffusion rate equation[3]
$u_1^* - u_2^* = -D_{12}\frac{n^2}{n_1 n_2}\frac{dn_1/n}{dr^*} + \frac{n(m_2 - m_1)}{m_1 n_1 + m_2 n_2}\frac{d\ln p^*}{dr^*}$ converted to dimensionless form. It is apparent from equation (2.8) that the pressure and density gradients may result in relative diffusion of the light and heavy components; the diffusion produced by the density gradient tends to equalize it, while the diffusion created by the pressure gradient tends to separate the two components; thus the two types of diffusion work in opposite directions. Therefore it is necessary to produce high-speed rotation and establish a powerful radial pressure gradient in order to intensify the separation of the two components. This is the basis of our approach to separation of components of different mass by electromagnetic acceleration of an ionized gas.

Entry conditions: $r = 1$, $\rho = \rho_0 = 1$, $u = u_0 = 1$, $T = T_0 = 1$, $v = v_0 = 1$, $p = p_0 = (\Gamma M_0^2)^{-1}$, $u_i = 0$, $\rho_i = \rho_{i0}^*/\rho_0^* = \text{const}$ $(i = 1, 2)$.

If the gas is injected tangentially through the outer wall, then the ratio of the radial velocity to the tangential velocity (ε) is much less than 1, so that that the term ε^2 in equations (2.4) and (2.6) may be ignored; thus we obtain

$$\frac{dp}{dr} = \rho v^2/r \tag{2.4.1}$$

$$\frac{\rho u}{(\Gamma-1)M_0^2}\frac{dT}{dr} = u\frac{dp}{dr} + \delta\left(\frac{v_e}{r} + v\right) \tag{2.6.1}$$

From equations (2.1)-(2.6) and the entry conditions we obtain the rotation speed and temperature distribution:

$$v = \frac{(1+v_e)e^{\frac{\delta}{2}(1-r^2)} - v_e}{r} \tag{2.9}$$

$$T = 1 + \frac{(\Gamma-1)}{2}\mu_0^2(1-v^2) + \frac{(\Gamma-1)M_0^2\delta v_e(1+v_e)}{2}e^{\frac{\delta}{2}}\left(li\,e^{-\frac{\delta}{2}r^2} - li\,e^{-\frac{\delta}{2}}\right) \tag{2.10}$$

where

$$li\,x = \int_0^x \frac{dx}{\ln x}$$

Using equations (2.7) and (2.4), by simple manipulation we convert equation (2.8) into

$$\frac{d\ln y}{dr} = -\frac{\frac{m_1}{m_2}(1+y)(1/y - 1/y_0)}{rD\sqrt{T}} + \frac{\left(\frac{m_2}{m_1}-1\right)(1+y_0)\Gamma M_0^2 v^2}{\left(1+\frac{m_2}{m_1}y_0\right)rT} \tag{2.11}$$

To solve equation (2.11) by successive approximations, we select the equilibrium distribution ($D\to\infty$) as the zeroth approximation,

$$y^{(0)} = K(r) = y_0 \exp\left[-\int_r^1 \frac{\left(\frac{m_2}{m_1}-1\right)(1+y_0)\Gamma M_0^2 v^2}{\left(1+\frac{m_2}{m_1}y_0\right)rT}\,dr\right] \tag{2.12}$$

Then the Nth approximation is

$$y^{(N)} = K(r)\exp\int_r^1 \frac{\frac{m_1}{m_2}(1+y^{(N-1)})(1/y^{(N-1)} - 1/y_0)}{Dr\sqrt{T}}\,dr \tag{2.13}$$

The magnetic effect coefficient δ expresses the strength of the effect produced by the magnetic field. The greater this effect, the greater the value of $|\delta|$. It is apparent from equation (2.9) that when $\delta\to\infty$, v reaches a limiting value $-v_e/r$ which we will call the limiting velocity. Why is the rotary velocity subject to limitation? When the gas is accelerated by the electromagnetomotive force, the tangential magnetic lines of force produced by

motion of the ionized gas create a reverse electromotive force equal to v^*B_0 which resists the motion of the gas; its direction is opposite to that of the impressed electromagnetic field and its magnitude is directly proportional to the speed. When the velocity v reaches a certain value the reverse electromotive force balances the impressed field, the current becomes zero, and the electromagnetic forces cancel, so that the gas cannot be further accelerated and reaches its limiting velocity. By suitably choosing the magnitude of the electromagnetic field, the limiting velocity can be made relatively large. For example, when $r_0^* = 50$ cm, $r_1^*=10$ cm, $B_0 = 1{,}000$ G, $v_0^* = 0.4$ m/sec and $E_0 = 50$ V/m, high-speed rotation of the gas at a limiting velocity of 2,500 m/sec can theoretically be achieved.

Calculations for Application to Isotope Separation

The magnetohydrodynamic solution for a two-component gas given above can be used to calculate the separation constant for an electromagnetic centrifuge separator. We define the homopolar separation coefficient as $\alpha = \frac{n_1/n_2}{(n_1/n_2)_0} = y_0/y$; from equations (1.12) and (1.13) we obtain the zeroth and Nth approximation values of α as

$$\alpha^{(0)} = \exp \int_r^1 \frac{\frac{m_2 - m_1}{m_1}(1 + y_0)\Gamma M_0^2 v^2}{\left(1 + \frac{m_2}{m_1} y_0\right) rT} dr \tag{3.1}$$

$$\alpha^{(N)} = \alpha^{(0)} \exp \int_r^1 \frac{-\frac{m_1}{m_2}(1 + y^{(N-1)})(1/y^{(N-1)} - 1/y_0)}{Dr\sqrt{T}} dr = \alpha^{(0)}\eta_N \tag{3.2}$$

where $D < 0$ and $\eta_N < 1$. In general, the larger $|D|$ is, the closer η_N is to 1. In normal states, the stable isotopes Ne^{20} and Ne^{22} are present in proportions of 90.65 and 9.35 percent respectively, so that $y_0 = 0.1031$, $m_2/m_1 = 1.1$, and $\Gamma = 5/3$; choosing $\delta = -\frac{1}{2}$, -1 and $-\frac{3}{2}$, $M_0 = 0.3$ and 1.2, $v_e = -10$, and $D = -10$ and $-\infty$, we obtain the results given in Figs. 2-4 (N = 2). As a specific example, when $r_0^* = 50$ cm, $\sigma = 10$ ohm^{-1}-cm^{-1}, $r_1^* = 15$ cm, $\rho_0^* = 10^{-3}$ g/cm^3, $B_0 = 1{,}000$ G, $u_0^* = 5$ cm/sec, and $\delta = -1$, we find from Fig. 3 that if $r = 0.34$ we can obtain an isotope separation coefficient $\alpha = 1.85$ for concentrated Ne^{20} at a flow rate of 4 g/sec. This indicates that electromagnetic centrifuge isotope separation gives rather high isotope separation values and a large yield. It is evident from equation (3.2) that for the same rotary speed, the lower the temperature the greater the separation coefficient. By using low temperature ionization or laser ionization of the gas, we can make better use of the advantages of electromagnetic centrifuge separator.

It is evident from Fig. 2 that when $|\delta|$ is small, v increases rapidly with increasing $|\delta|$, but when $|\delta| > 10$, v decreases more slowly with increasing $|\delta|$. When there is a limiting velocity, if the impressed electromagnetic field is increased without limit there will be no improvement in the

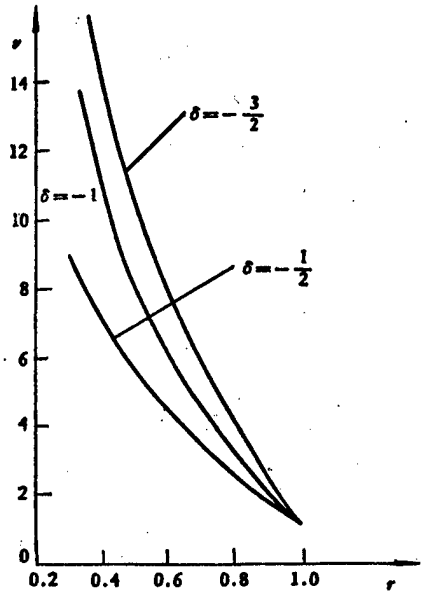

Fig. 2. Velocity Distribution

D = -10, M_0 = 0.3, v_e = -10.

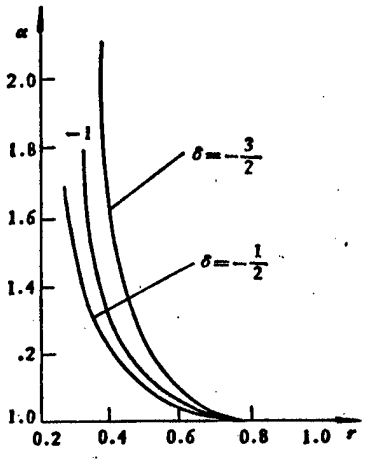

Fig. 3. Separation Coefficient Distribution

D = -10, M_0 = 0.3, v_e = -10.

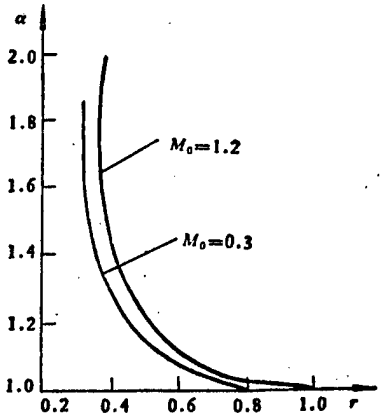

Fig. 4. Separation Coefficient Distribution

D = -10, v_e = -10, δ = -1.

separation coefficient. In addition, $|\delta|$ is inversely proportional to the yield $\rho_0^* u^*$, so that by suitably selecting δ we can obtain rather high separation coefficients and rather large yields.

We thank Comrade Hu Wenrui [5170 2429 3843] for enthusiastic guidance and assistance.

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CSO: 4008/171

DEVELOPMENT OF ROBOT TECHNOLOGY IN SHANGHAI SURVEYED

Dalian ZUHE JICHUANG [MODULAR MACHINE] in Chinese No 5, 1983 pp 27-32

[Article by Lu Xueshi [0712 1331 6108] and Xu Huichang [6079 1920 2545], Precision Machinery Research Laboratory, Shanghai Industrial College:
"Prospects for Application of Robots in China as Exemplified by Shanghai"]

[Text] Robots constitute a new field of science and a new technology which originated here and abroad in the last 10 to 20 years and are developing rapidly. They integrate the newest achievements in machinery, hydraulics, pneumatics, metrology, automatic control, computers and other scientific and applied technical fields. Many experts abroad even believe that development and improvement of robots will lead to the third industrial revolution.

In China, with its more than 1 billion people, there is much dispute over whether or not research and development in robot technology should be pursued. One view is that the main incentive for development of robots abroad is a lack of manpower and rising labor costs, while China has a large population and extensive manpower resources, and its current problem is finding extensive avenues for employment, so that with our population, the benefits would not outweigh the disadvantages. Another view is that China is technically backward and robotics is a sophisticated technology which is beyond the needs of our society in the current stage, so that it is not suited to China's circumstances, and it would be premature to pursue it.

But will research in robot technology be "unprofitable" and "premature?" Below we give our own views in connection with some facts from a survey of the Shanghai area.

China's Level in Robot Development and Applications and the Status of Their Use in Shanghai

China's first point-to-point robot was produced in Shanghai in 1958. At that time, foreign research in the field was also in its initial stage, and there was not a very large gap. But afterward, as a result of the extreme left ideological tide and the 10 years of chaos, development work was interrupted and we stagnated technically. A full 18 years passed before China's first robot technology dissemination station was set up in 1976, and by that time we were far behind foreign robot technology, lagging by about 20 years.

Following the smashing of the "gang of four" in 1976, there was considerable progress in robot research in China and in Shanghai. Its technical level can be summarized as follows:

1. China has already moved from importation of the robots required for manipulations in the nuclear power industry to their imitative manufacture and independent design, and has already developed small-series production capabilities. This favorably sets the stage for building nuclear power stations and developing other types of robots in China.

2. China already has the production capabilities and technical prerequisites for rational selection and introduction of various types of program-controlled robots in industrial branches and has already laid a good foundation for their use in a variety of fields.

3. Considerable research experience in the areas of high-precision teach-and-playback, multiple-linkage and magnetic-tape memory robots has already been acquired, which will shorten the time required for creating further reliable products for production use.

4. Research in such technical fields as robot vision, hearing, touch, computer control, artificial intelligence and the like has already taken its first steps.

Categories of Robots

There are many ways of categorizing robots. China currently uses the terms "anthropoid robot" [jigiren] and "manipulator robot" [jixieshou] and has not adopted the foreign term "robot" as such. Actually, the term "robot" as used abroad has no fixed definition, which leads to difference of opinion on the basic question of what a robot is.

If we provisionally use the broad classification of the technical development of robots given in Fig. 1, then when Japanese statistics report the existence of 100,000 robots, they are referring to categories A through H, which are also included in the Chinese use of the term, while in Europe and the United States only classes D through H or E through H are classified as robots.

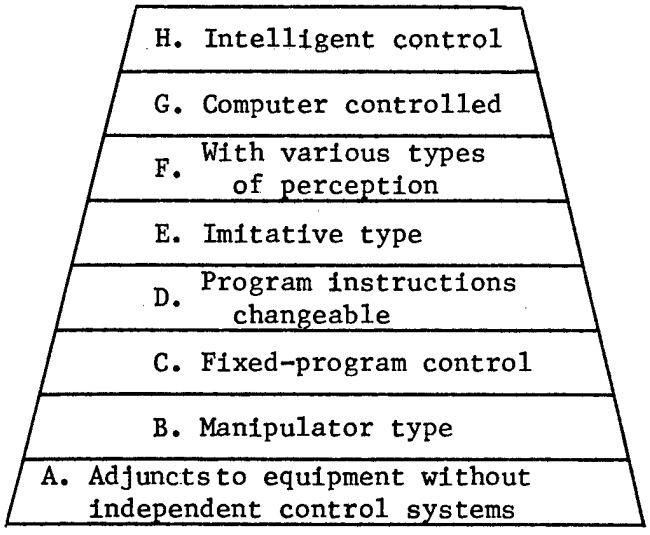

Figure 1

There are also differences of opinion in China, but there is an apparent majority view that the categories from E upwards should be called "anthropoid robots," while those below should be called "manipulator robots." Whether this subdivision is in agreement with the country's requirements has yet to be determined. For these reasons, the statistics given on development and finer classification are still given in terms of manipulator robots [generally translated simply as "robots" below].

Shanghai is the part of China which uses the most robots and has them in the greatest concentration. Their applications have already extended to electrical and mechanical devices, light industry, the foodstuffs industry, the electronics industry, construction, textiles, and handicraft products. According to incomplete statistics, between 900 and 1,000 robots of about 350 types have been fabricated in Shanghai (including a few general-purpose robots).

More than 160 plants are using these types of robots. The electrical and mechanical products industry is the biggest and most extensive user of robots in Shanghai. According to 1979 statistics, about 450 robots of about 150 types were used in this industry, accounting for half of all robots in use in Shanghai. About 81 plants were using robots. Breakdowns in terms of branches of industry, number of degrees of freedom, types of power, coordinate type, control method and the like are shown in Fig. 2.

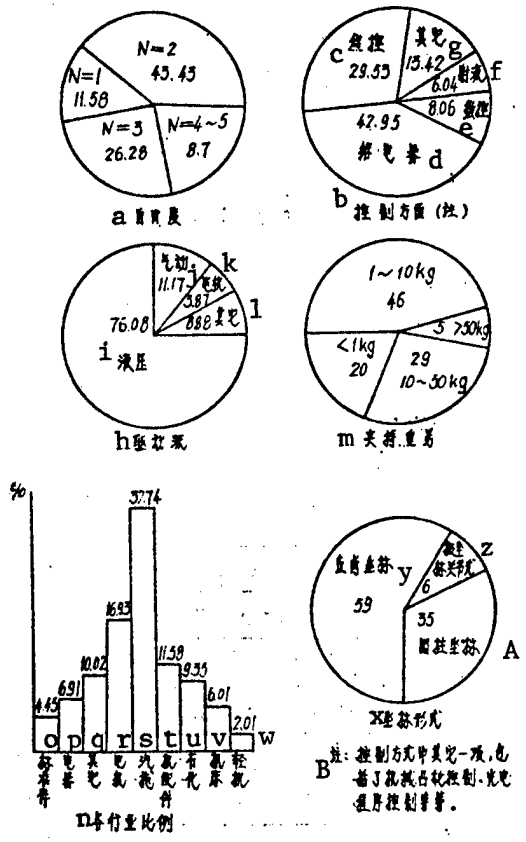

Figure 2.

Key: a. Number of degrees of freedom
b. Control method (see note)
c. Program control
d. Relay
e. Numerical control
f. Jet control
g. Other
h. Type of drive
i. Hydraulic
j. Pneumatic
k. Electromechanical
l. Other
m. Carrying capacity
n. Comparison of various industrial branches
o. Standard parts
p. Electrical equipment
q. Other
r. Electrical machinery
s. Automotive and tractor
t. Machine parts
u. Petrochemistry
v. Machine tools
w. Light machinery
x. Type of coordinates
y. Rectangular
z. Polar
A. Cylindrical
B. Note: Other types of control include mechanical cams, optoelectronic program control

Areas Currently Suitable for Development of Robot Technology

Is it currently "unprofitable" and "premature" for China to develop and apply robots? Such a broad generalization is clearly incorrect. We must understand clearly that in addition to being able to replace human labor, robots can perform labor of which humans are incapable; this is one reason why, even with our large population, we must use and develop robots and must not stop with relatively simple manipulators. In addition, it should be pointed out that if we import and develop robots in a realistic manner (rather than doing it blindly and for its own sake), we will be able to raise China's technical level and gain time, as well as speeding up our economic and technical reorganization and thereby shortening the time required for modernization. Below we briefly describe results that have been achieved in Shanghai's practical application of robots.

1. Many important types of modern industrial production require robots. Without them the manufacturers will not be able to achieve their production objectives or even to produce their products; therefore the use of robots has great viability and extensive prospects. For example, development of large-scale integrated circuits and other electronics components and the production of certain contraceptive products require the avoidance of direct contact by humans and are produced under sealed conditions, i.e. human breath must not come in contact with the products during the manufacturing process. When we use human labor in the production of integrated circuits, our acceptance rate is low. In the United States, IBM uses robot technology for totally sealed production, and the product acceptance rate has reached 100 percent; not only is product quality assured, but the products are reliable, labor productivity is increased and production costs are decreased, so that the products are highly competitive.

The petroleum drilling bits produced by the Shanghai No 1 Petroleum Machinery Plant are urgently needed for the development of China's petroleum resources. one drill bit blank weighs over 20 kg. The plant had always used manual labor in single-machine process-flow production, installing the cutters one by one in blanks containing five holes. Positioning accuracy was poor and the alignment to the axes of the inner holes was inaccurate, so that our products were inferior to similar foreign products and their manufacture involved a good deal of physical labor. Thus we could not meet our petroleum front's drilling footage requirements. In a technical modernization effort last year, the plant installed a double-gripper robot with tactile capability and set up an automatic drill bit blank processing line using robot manipulators, which made it possible to use a standardized chuck to grasp the drills; this automated machining assured product precision and allowed the acceptance rate to be increased greatly, in addition to which the number of personnel needed to tend and manage the entire line decreased from 5 to 1 or 2.

An alloy with a micropore structure similar to glass which has a disordered spatial arrangement of its atoms is a corrosion-resistant material with special magnetic properties and mechanical strength urgently needed by the country. For example, the noncrystalline alloy $FeCrPC_7$ has a corrosion resistance three times that of 18 percent Ni - 8 percent Cr stainless steel, and its magnetic properties are comparable to that of Fe-Ni permalloy. But this noncrystalline

material must be produced by fusing grains of the metals at 1,200°C and high pressure, cooling them by 1,000°C per second to -50°C and depressurizing them to vacuum conditions. Thus, manual operation by humans is impossible. Other operations, such as liquefying old rubber tires, treating nuclear waste, welding in deep water, radiation monitoring and the like, can be performed by robots in ways that are beyond human capacities.

2. Robots are a way of balancing electricity use and increasing output value per unit energy consumption that must not be ignored.

Rational use of electricity is currently of concern to everyone. Shanghai has long been a relatively advanced part of the country in terms of its thorough use of energy resources, producing about $1,100 worth of output per ton of standard coal. But this is a low figure in worldwide terms; it is only 60.4 percent of the value achieved in Japan and 55.6 percent of that achieved in Germany; while the value achieved in France is almost double that achieved here, and Shanghai is also 13.7 percent below the figure of $1,260 achieved in India. Shanghai's energy conservation achievements in recent years have been realized primarily by readjustment of the economic structure and by making energy-saving improvements on the main pieces of improvement. Another method is to intensify management, balance energy consumption, level out peaks and valleys and expand nighttime power consumption. The Shanghai No 9 Radio Plant's good experience with nighttime use of robots has great value. Night operations can be conducted with only a few supervisors. The plant has fabricated more than 10 hydraulic and numerically controlled plastic injection machine robots, 6 punching machine robots, and 24 robots for pressure forming of metal. In daytime there are many workers and their labor productivity is somewhat higher than that of the plastic injection robots, so that in daytime humans and robots are used simultaneously; in the swing shift and night shift, the robots are used, along with a few workers to supervise and tend them, which has increased the shop's total output. In order to increase the output value per ton of standard coal, the Office of Electric Power has established different rates for daytime and night in the hope that enterprises will use electric power at night and not waste additional fuel. Unmanned factories, equipped with machines, in which "we see few people and hear only the sound of the machinery" and in which robots engage in production in place of humans in the still of the night are of great importance for the rational use of energy.

3. Robots are an excellent way of increasing labor productivity and output.

A socialist country's only way of raising the people's standard of living is to continuously raise its production standards and increase labor productivity per worker so as to produce huge amounts of social wealth. Shanghai-produced sewing machine needles have long been polished by human workers; this technology was obsolete and the needles had long been a scarce product on the markets. The output of the Shanghai No 1 and No 2 sewing machine needle plants accounted for almost all of Shanghai's sewing machine needle production. A few years ago, the No 1 plant developed an automatic needle polishing line consisting of 5 robots with 3 degrees of freedom, which not only decreased the number of workers needed from 7 to 1 or 2, but also increased daily output by 20 percent from 8,000 packages to more than 10,000. After the

successful development at Plant No 1, Plant No 2 immediately improved and upgraded its machinery on the basis of this experience, added two degrees of freedom (arm extension and retraction, right and left movement), and put an automatic needle production line consisting of five machines with 5 degrees of freedom into operation, for which it received an Office of Light Industry award for excellent equipment design. It is obvious that robots have great viability. The Shanghai Tractor Plant used an automated process line containing 11 hydraulic program-controlled robots with 4 degrees of freedom for milling the ends of 25-kg semiaxles as well as turning, rolling of screw threads, cold forging of splines and milling of keys; this increased productivity by a factor of 7 to 9. Certain rather large plants in Shanghai have already introduced automated lines for most machining, most axle-type and disk-type parts, so that the application for robots has become a necessity and has reached a relatively mature stage. For example, robots have already become essential components in the machining of compressor crankshafts at the Shanghai Refrigerator Plant, valve stems at the Shanghai No 5 Valve Plant, DZO axle ends at the Shanghai Special Electromechanical Machinery Plant, gas cylinder covers at the Shanghai Drive Machinery Plant, SH-760 vehicle engine separator pumps at the Shanghai Motor Vehicle Engine Plant and the like and have consistently given good service.

4. Protecting the workers' legitimate interests and protection of labor are an unswerving policy of Chinese socialism.

After the Taikang Food Products Plant in Shanghai received and packaged food products, it had to quickly place them in the freezer for quick-freezing. The quick-freezer was bitter cold, with temperatures below -20°C. In serious cases, prolonged work in this environment could cause rheumatism and crippling of the entire body. Following its development of a numerically controlled refrigerator robot in 1980, the operations of transporting food products into the freezer, recognition of locations, movement, and removal of goods were automated. This was the first time that freezers not requiring humans to operate them had been developed in China; the productivity per hour was potentially increased to 150 trays per hour. The Shanghai Measuring and Cutting Tools Plant carried on quenching of large quantities of high-speed tool speed in large lots, with high quality requirements, but the high-temperature steam produced by the salt-bath furnaces during the quenching process was harmful to humans. The plant installed five pneumatic program-controlled robots to control four modular salt-bath lines with temperatures as high as 600-1,300°C and instituted automatic quenching of tools (which weighed 30 kg), thereby increasing its productivity by a factor of 2 to 3 and cutting manpower requirements in half while making it unnecessary to expose personnel to a high-temperature poisonous atmosphere. The Shanghai No 4 Standard Parts Plant's galvanizing shop was filled with chemical vapors and the parts (screen) to be lifted out were heavy, weighing up to 100 kg. After the plant developed a hydraulic numerically controlled galvanizing robot its situation was completely altered. Last year the Shanghai Yaohua Glass Plant developed a kiln-entrance robot which could be remotely operated by workers, thus avoiding the scorching environment at the kiln entrance. Hydrofluorcyanic acid is an intensely poisonous substance. Last year the Shanghai No 9 Vacuum Tube Plant introduced a rectangular-coordinate washing manipulator with 4 degrees of

freedom into its process for acid washing of glass picture tube casings, so that personnel were entirely removed from contact with the acid and output was increased to 60 tubes per hour, exceeding the output when human workers were used. The iron core oxide coating work area in the Shanghai Motor Vehicle Electric Machinery Plant was a high-dust environment which was seriously harmful to health. The plant introduced an oxide coating flow line using a bellows-type pneumatic robot which removed workers from the dusty environment. Thus it is evident that extreme environments not suitable for humans are important areas in which China can use robots.

5. We are a large country and we must gradually establish and develop our marine and space capabilities, which offers an important area for the use of robots. The exploration robot manipulator developed by the Shanghai No 3 Machine Tool Accessories Plant for the Office of Oceanography has been installed on the seagoing research vessel Kantan I and has proven useful. A certain research institute in Shanghai is currently doing design research on a robot, intended for work at the sea bottom, which can interchange several different types of jaws. The manually controlled ocean robot developed by institute No 704 for recovering intercontinental ballistic missiles from the ocean is an indication of the strategic significance of China's development of robots.

6. Remote border provinces such as Qinghai, Ningxia, Xizang, Xinjiang, Guizhou and Gansu are rich in resources, but economically backward and urgently in need of development. For example, the industrial output value totaled only 1.39 billion yuan in Qinghai, 1.36 billion yuan in Ningxia, 150 million yuan in Xizang and 3.14 billion yuan in Xinjiang, equivalent to 2.22, 2.17, 0.24, and 5.01 percent respectively of Shanghai's output value of 62.6 billion yuan. Thoroughly utilizing these areas' rich material and mineral resources to develop their economies is of great strategic importance to China. Because the border regions differ from the coast, having sparse populations and insufficient manpower and in particularly lacking workers with technical skills, these provinces are critical areas for the introduction and utilization of robot technology. This will not only provide a more advanced starting point, and upgrade these areas' production technology, but in addition can allow focused development and comprehensive utilization of their mineral resources in a relatively short time, thus rapidly altering their economically backward state.

7. Military uses.

8. They liberate workers from heavy and tiring operations.

At the Shanghai scientific and technical exchange meeting held in March 1983 the sewing machine industry proposed a key effort in the use of robots for removing burrs from the blanks for sewing machine cases. Because sewing machine cases weigh up to 7 kg and are manipulated by humans, machining them with emery wheels produces large amounts of dust and causes aching limbs and backs; thus the workers fervently wish to get manipulators into operation immediately. During precision casting, alloy additions are added to the melt at a high temperature; this work is extremely heavy and unsafe. In addition, the quality of the castings is extremely variable. The Shanghai Instrument

and Steel Molding Plant developed a hydraulic automated pouring robot with 4 degrees of freedom which was combined with a pressure casting machine, which satisfied output requirements and mechanized pressure casting, and in addition freed the workers from heavy physical labor. The Shanghai Steam Turbine Plant's turbine blade die forgings weigh as much as 80 kg each and manipulating them is extremely toilsome. Use of a cylindrical-coordinate program-controlled robot with 3 degrees of freedom at the steam hammer was welcomed by the workers, and the device has given continuous good service to date. The development of punching machine robots in Shanghai has a long history. For example, the Shanghai May 1 Electrical Machinery Plant uses 60-ton and 100-ton punching machine robots to produce electrical machine rotor plates and carbon steel rings; the Shanghai Electrical Machinery Plant uses a DC-motor-driven 250-ton punch press and robot to produce electric motor stator plates weighing up to 2.5 kg; the Shanghai Standard No 1 Standard Parts Plant has a multiple-position cold-heading robot, and the No 2 Standard Parts Plant uses a robot on the 100-ton punch press for M12-30 double ended studs; all of these devices have been in normal operation for at least 4 or 5 years, functioning stably, safely and reliably, and have achieved rather high output, solving the long-standing problem of breaking of fingers in the press, the threat of what was called the "tiger's mouth," so that the workers have been grateful for the robots. The Shanghai Machinery Plant produces circular saw blades weighing up to 40 kg; the manual labor involved in quenching them was very heavy. After a suspension-type quenching robot was developed, the workers only had to maintain and tend it, and the quality of tempering became rather consistent. The No 2 Welding Plant produced iron glands; in the past these devices were produced on a single machine, and since each piece weighed as much as 60 kg, so that the effort involved in handling them was naturally very great. After a manipulator was developed and integrated into an automated production line, the production situation was completely transformed.

It is evident from the examples from Shanghai quoted above that considering the rational development and application of robot technology in China to be unnecessary because of large population, or premature, or unsuited to China's conditions, simply bespeaks incomplete analysis and understanding. But to neglect the factors of China's large population and extensive manpower and blindly and indiscriminately expend large amounts of money to develop robots merely in order to replace manpower would indeed be unprofitable.

Problems in the Use of Robots in Shanghai

Because the development of program-controlled robots in Shanghai has been basically mastered, there are many cases of their normal use in such areas as electroplating, forging, punching, plastics injection molding, metal cutting, pressure casting, heat treatment, measurement and the like. But there are still a good many problems involving their use that need to be solved. For example, although more than 160 plants in Shanghai are already using robots, this is only 2 percent of the 8,017 industrial enterprises in the city, which indicates that there is still considerable room for their dissemination. In addition, there are a variety of problems with the 900-1,000 robots that have already been developed. As Fig. 3 indicates, fully 46 percent of robots are idle or have even been dismantled for various reasons.

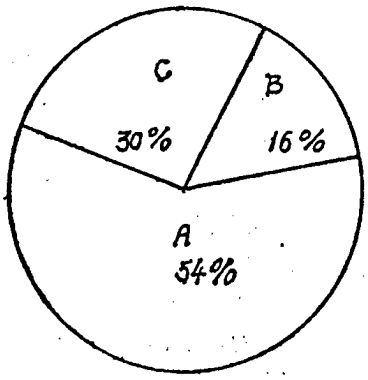

Figure 3.

Key: a. Providing normal service
b. Usable but not in use
c. Idle or dismantled because of problems

Thus if we do not find out the causes and overcome them, this will hinder the application and development of robot technology in China. Overall, the problems are of the following types.

1. Because China has no specialized plants to produce manipulators, the manipulators currently in use are all built in-house. Some of the manipulators were built hastily and are not in accordance with requirements, or have deficiencies in the original design, or do not operate stably or have many malfunctions and poor reliability, so that they do not give normal service. For example, the robot used for quenching heat-treated automobile springs at the Shanghai automotive steel leaf spring plant had 5 degrees of freedom and used step selector program control. Each of the workpieces (steel automotive leaf springs) weighed 40 kilograms, so that this robot was sorely needed in production, but because of its inaccurate positioning, the robot could not grip and transport the workpieces in a way suited to the quenching process; as a result, it was taken out of service. The crankshaft milling robot at the Shanghai Automotive Engine Plant and the automatic diesel engine bezel turning robot at the Shanghai Diesel Engine Plant were taken out of service because the impact of the pneumatic parts often damaged the cutting tool when the part was positioned. The copying lathe robot developed for production of electric motor axles at the Shanghai Gexin Electrical Machinery Plant was also taken out of service because of poor manufacturing precision and inaccurate positioning.

2. Poor quality of parts and components results in too short a mean time between failures, so that the manipulators do not give normal service. For example, the rubber-diaphragm robot for handling silicon steel plate on the 200-ton punch press developed by the Shanghai No 5 Electrical Machinery Plant and the automatic turning manipulator for 25-kg cranks at the Shanghai Lixin Electrical Instrument Plant were abandoned because of problems with the electrical instruments and hydraulic components which resulted in poor positioning accuracy. The program-controlled robot with DC drive motors developed by the Shanghai Electrical Machinery Plant was first used on the 160-ton punch

press to produce 2.5 kg electric motor stators, but because of problems with the electrical components it did not give good service and was ultimately dismantled. The program-controlled 165F robot with 4 degrees of freedom for use in low-pressure casting of gas cylinder tops at the Shanghai Gas Turbine Plant was dismantled because overheating of the hydraulic components affected its operation. The hydraulic press tending robot at the Xincheng Automotive Parts Plant has been idle for 2 years because the numerical control unit broke down shortly after development.

3. Production of "teach and playback" robots has not yet been organized and there is a lack of modular robots. As a result, the robots in use lack the necessary versatility and cannot be adapted to multiple-variety, small-lot production; if product specifications change or a product is discontinued, the specialized robots become worthless. The workpiece positioning and removal robot used for tractor and automotive semiaxles at the Shanghai Electrical Equipment Forging Plant (for 20-kg workpieces) and the gear blank positioning and removal manipulator used for the Fengshou 35 final reduction gear blanks (workpieces weighing 18 kg) at the Shanghai Tractor Accessories Plant consistently gave good service and good results, but ultimately when the products were readjusted the original production line could not be adapted to the changed circumstances and the robots were taken out of service. The axle bearing packaging robots developed by the Shanghai Axle Bearing Plant was designed for the 305 and 206 axle bearings and gave good service. But this plant produces a rather large variety of axle bearings and this robot could not be adapted to them, so that it ultimately did not give the proper service. The washing robot with 4 degrees of freedom at the Shanghai Combined Clamp Plant was well received, but when the production assortment was changed it eventually became worthless. A numerically controlled cylindrical-coordinate robot with 4 degrees of freedom in the hot punching shop at the Shanghai No 4 Standard Parts Plant was developed at the cost of considerable effort and used with a special-purpose hydraulic forming machine; it gave good service, but when the size of the product was decreased it could not be adapted and was abandoned. The bakelite forming press robot in the Shanghai Electrical Bakelite Plant was also insufficiently adaptable and was taken out of service when there was a rather major change in the product.

4. Because robots have lacked the proper strength, visual capabilities, and automatic microscopic distance and similar compensating features and have had poor adaptive capabilities, they have not been able to give normal service under real production conditions and even damaged themselves or the machines with which they were designed to work. The gear blank robot at the Shanghai Automotive Gear Plant was reliable and rather efficient when used for reaming gears, but after it was put into service it was found to be too simple, and the reaming quality did not meet the blueprint requirements, so that it was necessary to add an automatic compensating mechanism. The general-purpose cylindrical-coordinate manipulator with 5 degrees of freedom produced by the Shanghai No 2 Machine Tool Accessories Plant and the JS-1 polar-coordinate general-purpose robot developed by the Shanghai Tractor Gear Plant have both been exhibited, but have never been usable in production because control is too poor, they actually cannot be positioned as desired, and compensations cannot be made, to say nothing of their lack of adaptive capabilities. The forging robot

produced by the Shanghai Machine Tool Cutting Tip Plant cannot grip the workpiece if its dimensions or position are changed, with the result that it cannot be used as it should. In the Shanghai No 1 Electrical Wire Plant's final-design copper coil manipulator, control is implemented through machine perception based on a picture tube, but because of production failures in the production of the tubes, the device cannot be used. Thus it is evident that the study and development of measuring components is extremely important for assuring that manipulators will operate normally under real production conditions.

5. Because of failure to provide some necessary accessories for robots (which take account of the shape, weight, sequence machining route, precision, positioning and the like of the workpiece), robots have been unable to adapt to production needs. A robot used by the Shanghai Machine Tool Plant for workpiece feed and removal in the grinding of main axles proved inaccurate in positioning and had to be supplemented with a support frame and other accessories. The automatic robot for tinning radiators at the Shanghai Automotive Parts Plant was well designed, with up-down, left-right and forward-back movement and the arm assembly could turn over easily, making it able to replace manual labor in transporting radiator cores weighing up to 80 kg for tinning, washing and the like and in addition was able to remove the workers from a high-temperature environment containing poisonous gases. But because of disagreements, the plant failed to spend the material and labor resources needed to add the requisite accessories, with the result that the robot was difficult to use and its output did not meet requirements, so that after completion it was dismantled by the leadership. A hydraulic circular-coordinate program-controlled robot with 4 degrees of freedom developed by the Shanghai Heavy Locomotive Plant was usable, but because of chaotic management during the period of the "gang of four" the problems of providing the necessary accessories and adjusting production layout were never solved and it was ultimately disassembled. A rotor plate robot for the 160-ton punch press at the Shanghai Renmin Electrical Machinery Plant was simple in design and reliable in operation, but because a suitably stable gas source, silicon steel plate positioning and materials transport were not provided, it did not give proper service. Because the robots used in the Shanghai punch press industry were not designed as complete sets of equipment, their effectiveness was lowered and many of them have been dismantled.

6. The production layout has not taken complete account of the capabilities and characteristics of the robots used. In many cases, robots have been used with the processes, equipment and production lines that were used previously with human labor, making it impossible to coordinate their work. For example, the feed and removal robot for gear blanks at the Shanghai Tractor Gear Plant, the DSY-01 spot welding robot used at the Shanghai Electric Welding Machinery Plant, and the motor vehicle floor spot welder used in its initial design at the Shanghai Motor Vehicle Plant all cost more than 200,000 yuan each, but when they were brought into the plants it was found that they could not be adapted to existing production lines, so that they have been idle for several years. Instances of the opposite kind, in which a comprehensive layout was arranged, giving excellent results, are also numerous. For example, the Shanghai Standard Parts Company uses robots rather widely and achieves rather

high output; as of last year its 5 plants had already put 20 robots into use, and this year, as output increases, the number will be expanded considerably. The respects in which they have been successful include not only reliable design, simple and rapid operation, and use of spring-type clamps in most of the grasping mechanisms, but also rational production layout centered on the cold heading units, yielding excellent results. The Changning, Zhongguo, Shanghai and Hongxing axle bearing plants of the Shanghai Machine Parts Company are nationally known for the output and quality of their axle bearings. The technical requirements imposed on axle bearing production are rather stringent. These plants readjusted their production structure several years ago and built an extensive series of automated production lines equipped with robots for such processes as extra-high-precision grinding of inner and outer axle bearing channels, inner circular grinding, packaging, turning and grinding of the inner race, punching, turning of the outer race, grinding of inner rings and outer slots, maintaining proper configuration, reaming of inner race, turning over inner rings, and cutting of channels in small bearing races, thus achieving mechanization and automation of production and assuring consistent high output and excellent quality of axle bearing production. The number of robots in use in the four plants is as high as 48. At the Xincheng Automotive Parts Plant in Shanghai the output and efficiency of the punch press robots were inferior to those of human operators, so the plant changed the production layout for punching of the Jiefang lamp housing, redesigning ordinary punch presses into 6-position presses and producing robots for the lamp housings, thereby achieving results much superior to those of human operators; as a result, for the past 5 or 6 years the manipulators have been consistently given normal operation on the production line.

Some Views on Development of Robots in China

1. In developing robot technology, China should not aim simply at replacing manpower.

2. In applications, the necessary auxiliary equipment must be provided in accordance with the characteristics of the robots, and various types of program-controlled robots should be put into wide use, rather than indiscriminately aiming at sophisticated robots; this approach will yield the best results. Even in Japan, which uses the most robots, robots of this type account only for somewhat more than half of the 100,000 robots in use, and only 14,000, or 14 percent, have magnetic tape or drum memory and a teach and playback capability. There are about 4,000 of these sophisticated types of robots in the United States, only 20 percent of the total number.

3. It is particularly important to develop modular robots in China. The progress made in this area by the Dalian Research Institute of Modular Machine Tools and the Jilin Research Institute of Machine Tools has provided effective experience for China's development and use of modular robots.

4. We should change our initiative production approach and import key parts and components and production technologies in order to win time and to accelerate the development of sophisticated robots. We have carried out imitation research in teach and playback robots for 4 or 5 years in almost

10 different organizations and spent 2 or 3 million yuan on the work, but we have not yet made a breakthrough and put them into production and use. The situation in China is that our design and manufacturing capabilities are adequate, but the key problem is that we lack such basic elements as measurement, drive, and control components or that their quality is not up to requirements. If this problem is not resolved, it will be difficult for us to produce sophisticated robots with magnetic tape memories. And if we did make a herculean effort and developed such devices, it would be difficult to organize their series production. But mastering the technologies for producing such sophisticated robots is important for national defense, scientific research, education, public health and several other parts of the national economy.

5. We should intensify research and development in such areas as tactile and visual perception, "knowledge and concepts," computer signal processing, natural language comprehension, goal-directed planning, and reception of non-visual information. This technical reserve is of great strategic importance for carrying out the four modernizations and decreasing the gap which separates us from the world state of the art.

6. We should establish an effective center for theoretical research and technical development of robots within institutions of higher education or scientific research organizations.

7. We must intensify international specialized exchange activities.

8480
CSO: 4008/132

APPLIED SCIENCES

NEW TELECOMMUNICATIONS OPTICAL FIBER DEVELOPED

OW130853 Beijing XINHUA in English 0703 GMT 13 Jan 84

[Text] Beijing, 13 January (XINHUA)--Chemists at the Chinese Academy of Sciences have developed a new optical fiber for experimental use in telecommunications, academy president, professor Lu Jiaxi announced here today.

President Lu said this was done under the guidance of the academy's academicians--an honorary title given to China's leading scientists.

Lu Jiaxi said that since its fourth session in 1981, the academicians have headed or guided many of the key research projects of the academy.

Academicians have been organized to appraise institutes' research findings or map out major research programs for the academy or the state or to study the feasibility of some key projects.

Many of their opinions concerning, for example, application of nuclear technology, development of integrated circuits and computers, marine engineering, separation of isotopes with lasers have won the attention of the central government and some already been adopted, he said.

The academy's chemists have devised a new polyurethane grouting material for use in the Gezhouba Dam against leakage. It stood the tests of Yangtze River's rare high crests last year.

They have also found new processes to extract vanadium from the vanadium-titanium-iron ores at Panzhihua in Sichuan and recover more copper, lead, zinc and gold.

Geologists have carried out research of geological structures, sediments and the morphology of China's seas and the nearby high seas and analyzed the prospects of oil and gas deposits. Major attention is now focused on the possibility of oil and gas reserves in the carbonate rocks of Southwest China, mainly in Guizhou, he noted.

Biologists have been working on research in ecology and comprehensive prevention of cotton boll weevils, the production of a vaccine against B hepitis by genetic engineering, preservation of fruit and vegetables, he said.

Mathematicians have worked out a model for the optimum national distribution of crude oil, which will save an estimated amount of 430 million yuan. Results in operations research have provided the optimum theoretical base for designing China's large open-cut mines. This will be applied to China's 70 major projects. This alone will save China tens of millions of foreign currency, he said.

CSO: 4010/35

MAJOR MEDICAL SCIENCE ACHIEVEMENTS MADE

OW101406 Beijing XINHUA in English 1325 GMT 10 Jan 84

[Text] Beijing, 10 Jan (XINHUA)--Beijing tackled 109 major projects in medical science in 1983, some of the results reaching advanced world levels, according to the Municipal Bureau of Public Health.

The achievements included solutions to a number of basic theoretical problems and discovery of new methods for preventing and treating common and recurrent diseases.

The Municipal Public Health and Epidemic Prevention Center succeeded in making a highly-efficient preparation for typing vi bacteriophage of salmonella typhi, a project universally regarded as important for tracing the sources of infection and the media of the spreading of typhoid.

The Beijing Lung Tumour Research Institute has conducted comparative studies of HLA (herd leucocyte antigen) among some of China's nationalities and areas. Based on an abundance of data collected through 190,000 experiments, the researchers found that there are marked differences between HLA from people in northern and southern China as a result of geographical differences. They also drew up the first map showing HLA in China, thus contributing to the worldwide research in this field.

In combating common and recurrent diseases, some institutes achieved good results in studying the incidence, geographical distribution, causes and degrees of harm of 10 nervous system ailments. The Chaoyang Hospital found a way of curing acute gas poisoning by using high-pressure oxygen, and its curing rate reached 87.5 percent.

CSO: 4010/33

BRIEFS

SHANGHAI ADVANCED MEDICAL ANALYZER--Shanghai, 22 Jan (XINHUA)--An advanced medical electrolyte analyzer for testing blood passed scientific assessment by a panel of specialists here yesterday. Requiring just a drop of blood taken from the fingertip, the instrument has been put to clinical use in six hospitals in Shanghai and Beijing, making a total of 1,448 tests. The meter, weighing 15 kilograms, can analyze a blood sample in 45 seconds. Previously, a lot of blood taken from the vein had to be used for the same purpose. The old type of instrument involved a complicated, time-consuming process. "The results show that it has reached advanced levels of similar foreign products," a spokesman for the panel said. The spokesman said this marked a new breakthrough in China's research in clinical biochemical analyzing meters and supermicro-analytic technology. Children who suffer from diarrhea are likely to fall victims to electrolyte disturbance. Death would be induced without quick understanding of the content of potassium, sodium and chlorine ions in their blood and timely infusion. It was made by scientists at the Shanghai Institute of Medical Apparatus. [Text] [OW220650 Beijing XINHUA in English 0643 GMT 22 Jan 84]

CSO: 4010/36

PUBLICATIONS

ANNUAL INDEX TO LASER JOURNAL PUBLISHED

Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese No 12, 20 Dec 83 pp 870-876

[Text] Annual Cumulative Contents of Volume 10, CHINESE JOURNAL OF LASERS (1983)

CSO: 4008/101

AUTHOR: XIU Hailou [0208 3189 2869]

ORG: None

TITLE: "Application of Complex Control in the Control System of Antitank Guided Missiles"

SOURCE: Beijing BINGGONG XUEBAO [ACTA ARMAMENTARII] in Chinese No 4, Nov 83 pp 28-35

TEXT OF ENGLISH ABSTRACT: Based upon the invariance principle [symmetry law], this paper analyzes the possibility of applying complex control in the control system of antitank guided missiles. The structure and the parameters of a compensation network of a practicable complex control system are obtained. Calculation results of a simulated system are also given.

This paper was received for publication on 11 December 1981.

AUTHOR: WANG SHAOCHUAN [3769 1421 1557]

ORG: None

TITLE: "Analysis of Signals of Reflected Laser Waveshape"

SOURCE: Beijing BINGGONG XUEBAO [ACTA ARMAMENTARII] in Chinese No 4, Nov 83 pp 9-20

TEXT OF ENGLISH ABSTRACT: Based upon the concept of equivalent section of reflection of laser targets, this paper proposes a general equation for calculating the laser waveshape reflected from a target. Analytical representations of laser waveshapes reflected from planar, spherical, and cylindrical targets are thus derived. The results of calculation are obtained with the aid of a computer which also produces the waveshape and the frequency spectrum. A theoretical basis and a computer reference are, therefore, supplied for the correct determination of the bandwidth of the receiver. In theory, a method of selecting the pulse width of laser emission is also proposed for the purpose of maximum utilization of the emitted energy if an axial length in the illuminated direction is present in the target.

This paper was received for publication on 19 June 1982

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TITLE: "A Study on the Effects of a Polyurethane Wear-reducing Additive in Propellant Grain"

SOURCE: Beijing BINGGONG XUEBAO [ACTA ARMAMENTARII] in Chinese No 4, Nov 83 pp 45-49

ABSTRACT: This paper introduces a polyurethane wear-retarding additive suitable for small arms. The additive is added internally to the propellant grain, instead of the firing barrel, to cause the characteristic of the propellant to be modified. Effects of the additive in prolonging the useful life of the gunbarrel are studied. Worn-out barrels are dissected to analyze the differences in burn, erosion, etc. brought about by the additive. Further studies on the possibility of extending the wear-reducing mechanism of the additive to explosives of other forms of guns are awaited in the future.

This paper was received for publication on 25 December 1981.

6248
CSO: 4009/31

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TITLE: The Application of Cyclic Codes in CDMA Systems

SOURCE: Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese No 4, 1983 pp 97-100

ABSTRACT: In this paper the following ideas are explained:

(1) Some cyclic codes, having good autocorrelative and crosscorrelative coefficients, are suitable to be used as code-sequences in CDMA systems. This paper analyzes the properties of these cyclic codes, and gives mathematical proofs for the same.

(2) A $(2^{\lambda} - 1, 2\lambda)$ cyclic code defined in this paper has equivalent correlative property and same address number with a Gold optimum seeking sets.

(3) Cyclic codes are more flexible than Gold optimum seeking sets. A $(2^{\lambda} - 1, 2\lambda + 1)$ cyclic code can get twice address number as a Gold optimum seeking sets; although a $(2^{\lambda} - 1, \lambda+1)$ cyclic code can get only two addresses, yet it has very good autocorrelative and crosscorrelative coefficients; and still more, cyclic codes can be used without subjecting to the limit of code length $n = 2^{\lambda} - 1$.

CSO: 4009/035

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TITLE: "An Inclusive Matching Method of Chinese Character Recognition and Its Application"

SOURCE: Beijing TONGXIN XUEBAO [JOURNAL OF CHINA INSTITUTE OF COMMUNICATIONS] in Chinese No 4, 1983 pp 52-54

ABSTRACT: This paper presents a new method of Chinese character recognition--"Inclusive Matching Method." The paper first introduces the principle of the method and then the experiments undertaken to prove the effectiveness of the method. In the experiments, 5,659 out of 6,000 commonly used characters are classified into 198 groups in accordance with character components and radicals. If only characters classified into one group are considered to be in correct classification, the correct classifying rate is 97.29 percent, but if the 121 characters which enter either of the two groups are also counted in the correct classification, the correct classifying rate becomes 99.43 percent.

CSO: 4009/035

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TITLE: "The Evaluation of Liquid Mixing Effects on Sieve Plate Efficiency Using Fiber Optic Technique"

SOURCE: Beijing HUAGONG XUEBAO [JOURNAL OF CHEMICAL INDUSTRY AND ENGINEERING (CHINA)] in Chinese No 3, Sep 83 pp 264-274

ABSTRACT: Longitudinal eddy diffusivities of liquid on sieve plates have been determined experimentally with fiber optic technique. The experiments were carried out in a rectangular simulator with air-water system. Two sieve plates were used: one with 5mm diameter holes and 7 percent free area of tray, the other 10 mm and 9 percent. The weir heights were ranged from 10 to 50 mm, as conventionally used nowadays.

The stimulus-response technique used was first proposed by Aris and later corrected by Bischoff. In the experimental work the tracer, here aqueous rhodamine-B solution being used, was not injected upstream inside the boundary of the active plate area, but upstream outside the boundary of that, i.e. injected into the liquid in the upstream downcomer, and the tracer concentrations were measured at two sections along the flow path. Consequently, the problem of a perfect delta function of tracer into the flowing system and the difficulty of uniformly distributing tracer along the section of injection were thus avoided.

Since the measuring probes were quite small in size (about 2 mm in diameter) and the tracer was not injected into the liquid on the plate, the flow pattern on plate would not be disturbed and the results should be more reliable than those reported previously in the literature.

The data have been correlated as follows:

(1) For Sieve plate with 5 mm holes

$$D_e^{0.5} = 0.0339 - 6.27 \times 10^{-4} h_w + 0.0165 F_T + 2.57 \times 10^{-3} L$$

(2) For Sieve plate with 10 mm holes

$$D_e^{0.5} = 0.0243 - 6.40 \times 10^{-4} h_w + 0.0121 F_T + 3.77 \times 10^{-3} L$$

And a generalized correlation for hole diameters from 5 to 10 mm is:

$$D_e^{0.5} = 0.0155 - 6.31 \times 10^{-4} h_w + 0.0275 F_T + 3.13 \times 10^{-3} L$$

where D_e = Eddy diffusivity, m^2/s

F_T = Vapor flow parameter based on total column sectional area, $(m/s)\ (kg/m^3)^{1/2}$

h_w = Height of weir above plate floor, mm.

L = Liquid flow rate, m^3/hr per m length of weir.

By using the eddy diffusion model and the eddy diffusivity found by the above correlations, the predicted Murphree efficiency agrees well with the actually determined one of a well-known precise experiment of Foss et al.

CSO: 4009/36

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TITLE: "Studies on Long Acting Contraceptives: Synthesis of 17 β-steroid Esters"

SOURCE: Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 18 No 10, 29 Oct 83 pp 741-745

ABSTRACT: This paper reports the process of synthesizing five steroid esters of nonethisterone and the 17 β-ester of norgestrel, in an experiment designed and carried out by the authors. The objective of the project, sponsored jointly by WHO, was to search for long acting contraceptives. Using dicyclohexylcarbodiimide (DDC) as the dehydrating agent and 4-dimethylaminopyridine (DMAP) as the catalyst, the steroid and its corresponding acid were allowed to react directly to produce yields of 60-90 percent. Appropriate reaction conditions were observed and discussed. Physical and spectrographic data of the products, studied by thin layer chromatography, ultraviolet, infrared, and mass spectrometry, and nuclear magnetic resonance are included.

This paper was received for publication on 11 May 1982.

6248
CSO: 4009/30

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TITLE: "The Even-odd Effect of the Pre-equilibrium Emission in 59Co, 60Ni, 63Cu, 64Zn(α, p) Reactions"

SOURCE: Beijing YUANZIHE WULI [CHINESE JOURNAL OF NUCLEAR PHYSICS] in Chinese Vol 5 No 3, Aug 83 pp 193-202

TEXT OF ENGLISH ABSTRACT: Energy spectra of protons emitted in 63Cu (α,p), 64Zn(α,p), and 60Ni (α,p) reactions are measured at E = 18MeV. The results demonstrate that fractions of pre-equilibrium emission in odd-A target cases are greater than those in even-even target cases. These experimental findings are analyzed with the exciton model theory. The odd-even effect in the pre-equilibrium emission of 59Co, 60Ni, 63Cu, 64Zn (α,p) reactions is further discussed. The authors believe that this is due to the fact that the fraction of pre-equilibrium emission depends heavily on the related binding and pairing energies while these energies have a systematic dependent relationship with the odd-even characteristic and the number of neutrons in the outer shell of the nucleus. The odd-even effect in the (α,n) reactions and other related problems are also investigated; the conclusion is consistent with the above.

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TITLE: "Depth of Hydrogen in Thin Films With Elastic Recoil Detection Technique"

SOURCE: Beijing YUANZIHE WULI [CHINESE JOURNAL OF NUCLEAR PHYSICS] in Chinese Vol 5 No 3, Aug 83 pp 203-210

TEXT OF ENGLISH ABSTRACT: This paper introduces the elastic recoil detection technique for analyzing the hydrogen content in thin films and its depth profile. ^{4}He+ ions at energy of 2.1 MeV, furnished by a Van de Graaff accelerator, are incident on the target tilted at an angle of 75°. Energy analysis of H forward scatter yields a depth resolution of $\leq$ 500Å near the surface regions and a sensitivity of 0.1 percent for ^{1}H to depths of $\leq$ 0.5 μm in solids. This method has been used for depth profile of hydrogen in plasma deposited a-Si and

silicon nitride films combined with Rutherford backscattering and nuclear reaction $^{16}O(d,p)\ ^{17}O$ techniques. The relations between hydrogen quantity in a-Si and the substrate temperature are given.

This paper was received for publication on 1 February 1983.

6248
CSO: 4009/26

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TITLE: "Types of Granitic Magma and Their Ore-bearing Characteristics in the Northern Section of the Xikang-Yunnan Axis"

SOURCE: Beijing YANSHI KUANGWU JI CESHI [ACTA PETROLOGICA MINERALOGICA ET ANALYTICA] in Chinese Vol 2 No 3, Sep 83 pp 174-178

ABSTRACT: The Xikang-Yunnan axis is China's famous south-north tectonic belt on the western margin of the Yangzi platform. In its northern section, there is an extensive distribution of different kinds of granite to form a granitic zone of a south-north orientation between two deep fractures. The paper divides the granites into the two large categories of the crust refusion S type and the upper mantle basic magmatic differentiation I type. The former, located within the platform, is closely associated with rhyolite and produces chiefly tin and tungsten. The latter, found in the transitional trough, is associated with gabbro and syenite and related to deposits of rare-earth, niobium and tantalum. With maps and laboratory data, the temporal and spatial distribution, the petrochemical properties, the ore-bearing characteristics, and the petrogenetic mechanism of these granites are discussed.

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TITLE: "Determination of Uranium in Ores and Dressing and Metallurgical Samples by XRF Spectrometry"

SOURCE: Beijing YANSHI KUANGWU JI CESHI [ACTA PETROLOGICA MINERALOGICA ET ANALYTICA] in Chinese Vol 2 No 3, Sep 83 pp 213-214

ABSTRACT: For the purpose of finding a simple and effective method overcoming the basal body effect, uranium absorption behavior of resins was studied to conclude that the 742 anion resin absorbs and washes faster because of its large pores. Finally, a procedure is formulated to use the 742 anion resin for static absorption in a sulfuric acid medium to isolate uranium for x-ray measurement. Test measurements were performed with 0.138 percent samples for 15 times: the standard deviation was computed to be 0.0027, the fluctuation coefficient 1.98 percent. A VRA.2 X-ray fluorescence spectrograph made in East Germany was used for the experiment.

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CSO: 4009/28

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